FJ-G880-US

DESCRIPTION

DATA SENDING SYSTEM

5   CROSS-REFERENCE TO RELATED APPLICATIONS
           This application is a continuation of PCT/JP99/04436
      filed on August 18, 1999.

                        Technical Field

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           This invention relates to data sending systems,
      particularly to a system in which plural data sending
      units share paths for data transmission, wherein an
      occurrence of parity error can be avoided at a data
15   receiving unit connected to said data transmission paths
      when any data sending unit does not perform data sending.

                   Background of the Invention

20   With the types of data and methods of data sending
      having become diversified, recent years have seen a need
      for a particular data sending system, in which plurality
      of data sending units share paths for high-speed data
      transmission through which each unit transmit the data
25   interactively, arise. To meet the need, paths for high-
      speed data transmission, such as bus-shaped or ring-
      shaped paths, wherein plural data sending units and the
      data receiving units receiving the sending data are
      connected to the path, are employed.
30   Figure 1 shows an example of an image data sending
      system. As shown in Figure 1, a network control unit 1
      performs the control and management over the whole ring-
      shaped network (dual optical ring network). In this
      example, a control unit 2 controlling and managing the
35   network, and a data receiving unit 3 receiving the image
      data which is transmitted through a ring-shaped network
      8, are provided in the network control unit 1. The former

control unit 2 performs the control and management over the whole network according to an instruction of operators given through a console unit 6, or a network control and management program stored in the control unit

5   2.

The latter data receiving unit 3 is permanently allocated to a predetermined logical path (channel), where it receives the data transmitted from one or a plurality of data sending units 4-1 ~ 4-3 and displays

10   the received data on a monitor 7. Each data sending unit 4-1 ~ 4-3 is allocated a logical path, for communication, through which the data sending unit transmits data to said data receiving unit.

Said each data sending unit 4-1 ~ 4-3 shares a

15   plurality of logical paths, to each of which each unit can send data in a free manner. The plural data sending units 4-1 ~ 4-3 send each image data, which is collected by each camera 5-1 ~ 5-3 provided to each unit 4-1 ~ 4-3, to the data receiving unit 3 by inserting the image data

20   into the logical path of said data receiving unit 3 in a time sharing order.

Figure 2 (a) and Figure 2 (b) show an example of the image data which is transmitted in the ring-shaped network described in the Figure 1.

25   Figure 2 (a) represents an example of a data sending format. Video signals from each camera 5-1 ~ 5-3 are converted into a variety of standardized video data signals (in this example, data signals with transmitting speed of 1,536 Mbps or 4,608 Mbps) and are stored

30   sequentially in the payload section (payload) in a SDH signal flowing through the dual optical ring network 8. Each SDH signal mentioned above is to be received by the data receiving unit 3 as a predetermined logical path signal.

35   Figure 2 (b) shows an example of image data which is inserted alternately into the logical path of the data

receiving unit 3. This example represents transport
streams processed by MPEG 2 image system (MPEG 2 - TS),
wherein no data to be transmitted exists in a time slice
between t 2 ~ t3 for data switching. Conventionally,

5   unspecified data is transmitted when no data to be
transmitted existed (all data sending units output
whatever they recognize an input). When the data sending
unit, to which the time slice is switched, has no data to
send, a time span occurs at which no data is inserted

10   into the time slice. Consequently, an unspecified data
(NULL, as a kind of unspecified data) exists in the
logical path during that time span. Thus, conventional
system has a problem in such a case that a parity error
occurs in the data receiving unit receiving sending data,

15   which determines that there is a circuit abnormality in
the path for high-speed data transmission.

Disclosure of the Invention

20   The purpose of this invention is to provide, after
considering a variety of problems mentioned above, a data
system comprising: a network having one or plural
sharable logical paths; a data receiving unit permanently
connected to the predetermined logical path in said

25   network; and one or plural data sending units sharing
said predetermined logical path and being capable of
sending data to said predetermined logical path; wherein
no parity error occurs in the data receiving unit when no
data to be transmitted exists in a data sending unit.

30   According to this invention, the data sending system
to be provided comprises a network consisting of control
paths and data paths, the control unit instructing data
sending through said control paths, one or plural data
sending units sending data to the one among the plural

35   logical paths used as said data path according to an
instruction from said control unit, and the data
receiving unit permanently connected to the one among the

plural logical paths used as said data path. Said control
unit has a determining section for determining the time
span during which no sending data exist in the logical
path connected to said data receiving unit, and for

5   instructing one of said data sending units to send dummy
data. Said data sending unit has a dummy data sending
section for sending dummy data, to which an appropriate
parity information is added by said instruction.

According to this invention, also, the data sending

10   system to be provided comprises the network consisting of
control paths and data paths, plural data sending units
each of which communicate through said control paths and
send data to one of the plural logical paths used as a
data path, and the data receiving unit permanently

15   connected to one of the plural logical paths used as a
data path. Said data sending units comprise the
identification request/status report section for
performing identification request and report of a data
sending status between each data sending unit by the

20   communication via said control paths, the determining
section for determining the time span during which no
sending data is existed in the logical paths connected to
the data receiving unit by said identification request
and report, a scheduling section for performing a

25   scheduling process to send the dummy data during the time
span, and the dummy data sending section for sending the
dummy data to which the appropriate parity information is
added according to said scheduling.

According to this invention, in addition, the data

30   sending system to be provided comprises the network
including data path, one or plural data sending units for
sending the data to one of the plural logical paths used
as said data path, and the data receiving unit
permanently connected to one of the plural logical paths

35   used as said data path. Said data sending unit comprises
the scheduling section for performing the scheduling
process of a predetermined time span during which no

sending data exist in the logical paths connected to said receiving unit, and the dummy data sending section for sending the dummy data, to which the appropriate parity information added, during the time span.

5   In this invention, at least one of said data sending unit sends the dummy data, to which the appropriate parity information is added, to said data receiving unit. Thus, parity error occurrence in the data receiving unit is avoided.

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Brief Description of the Drawings

          FIG. 1 is a graphical representation showing one example of the image data sending system.

15   FIG. 2 (a) and FIG. 2 (b) are graphical representations showing one example of the sending data in the system described in FIG. 1.

          FIG. 3 (a) and FIG. 3 (b) are graphical representations of the first embodiment of this

20   invention.

          FIG. 4 (a) and FIG. 4 (b) are graphical representations showing one example of dummy data sending, which is introduced by this invention.

          FIG. 5 is a flow chart (1) representing one example

25   of the dummy data sending control performed in the first embodiment.

          FIG. 6 is a flow chart (2) representing another example of the dummy data sending control performed in the first embodiment.

30   FIG. 7 (a) ~ 7 (c) are graphical representations of the second embodiment of this invention.

          FIG. 8 is a flow chart (1) representing one example of the dummy data sending control performed in the second embodiment.

35   FIG. 9 is a flow chart (2) representing another example of the dummy data sending control performed in the second embodiment.

FIG. 10 (a) and FIG. 10 (b) are graphical representation of the third embodiment of this invention.

FIG. 11 is a flow chart representing an example of the dummy data sending control performed in the third embodiment.

Description of the Preferred Embodiment

Both figure 3 (a) and Figure 3 (b) show the first embodiment of this invention, and both Figure 4 (a) and figure 4 (b) represent one example of the dummy data sending introduced by this invention.

In this example, the control unit 2 is the center for managing the dummy data sending control. Incidentally, a specific example of the system, in which the embodiment shown in Figure 3 (a) and Figure 3 (b) is applied, is the same conventional one as described in figure 1. Therefore, each reference numeral used in the ring-shaped paths 8 and the blocks 2 ~ 4, which described in Figure 3 (a) and Figure 3 (b), respectively, is the same one used in figure 1. The ring-shaped path 8-1 and 8-2 each represents the control path 8-1 and the data path 8-2, which is each logically allocated in the payload section in the SDH frame transmitted through the dual optical ring network.

In figure 3 (a), the control unit 2 selects one or plural data sending units 4-1 ~ 4-n, which send data according to an instruction from the console 6 (see figure 1), and give a data sending instruction through the control path 8-1 to the selected data sending unit. The selected data sending unit 4-1 ~ 4-n send the data, consisting of the image shot with camera 5-1 ~ 5-3 (see figure 1), to a predetermined path on the data path 8-2 which is specified by the control unit 2. The image data is to be received and restored by the data receiving unit 3 permanently connected to the predetermined path.

When plurality of data sending units 4-1 ~ 4-n are specified, the image data from each data sending unit 4-1 ~ 4-n is inserted alternately into said data path in the time sharing order. When there is no image data to be sent, the dummy data sending control is performed to prevent parity error in the data receiving unit 3.

Figure 3 (a), Figure 4 (a), and Figure 4 (b) show one example of the dummy data sending control.

In this example, no data to be sent exist in the time slice between t 2 ~ t 3, wherein the data sending unit 4-2 transmits a dummy data for the time slice. The figure 3 (a) represents a following process: An instruction from the control unit 2 forces the data sending unit 4-1 to stop sending data at time t 1 when the data sending unit 4-2 starts sending data, simultaneously. Then the data sending unit 4-2 stops sending said data at time t 2 and starts sending data at the same time. Finally, the data sending unit 4-2 stops sending said dummy data at time t 3 when the data sending unit 4-3 starts sending data, simultaneously.

For comparison, a conventional case shown in Figure 2 (b) is represented in figure 4 (a). When the data sending unit, to which a data sending for the time slice between t 2 ~ t 3 is allocated, has no data to send, it results, as mentioned above, in the existence of NULL data (all "1") or unspecified data. As a result, a parity error occurs in the data receiving unit 3.

A case of dummy data shown in Figure 3 transmission is represented in Figure 4 (b) where appropriate parity bits (P) are further added to said dummy data, (for example, the NULL data consisting of "1" only) according to its data length. Sending of such a dummy data enables the data receiving unit 3 to constantly receive normal data from one or plurality of data sending units 4-1 ~ 4-n. Thus a possibility of false determinations, including determination of a circuit abnormality due to parity

error, is eliminated.

Figure 5 and Figure 6 are the flow charts representing dummy data control shown in Figure 3 (a). Explanation of said flow chart will be presented with reference to a more specific units block constitution shown in Figure 3 (b).

Figure 5 is a flow chart representing the dummy data sending control on the start of the control unit 2. Upon starting by being supplied with power, the identification request section 21 in the control unit 2 issues an status acquisition command to all data sending units 4-1 ~ 4-n in the system (S 101). On receiving said status acquisition command, each data sending unit 4-1 ~ 4-n, using the status report section 41, reports the status of each sending unit itself, in this case, reports a paths with no sending data to the control unit 2 (S102).

Then, the control unit 2, using the determining section 22, determines from said report whether the path with no sending data exist (S 103). When the path with no sending data exists, the control unit 2 issues the requisition command for transmitting the dummy sending data, based on scheduling data in the scheduling section 23, to a predetermined unit among the data sending units 4-1 ~ 4-n (S 104). Receiving said command, the predetermined data sending unit, using the dummy sending section 44 in the sending/receiving section 42, sends the dummy data to the path with no sending data (S 105). As described above, the control unit 2, at its start, recognizes the path with no sending data preemptively and automatically, and the unit among the data sending unit 4-1 ~ 4-n, instructed by said control unit 2, performs the dummy data sending control. In this manner, a detection of the false parity error by the data receiving unit 3 is prevented.

Figure 6 is a flow chart representing the dummy data sending control when the control unit 2 runs under a

normal condition.

In this case, the identification request section 21 in the control unit 2 also issues the status acquisition command, periodically or according to the needs, to each data sending unit 4-1 ~ 4-n, which is required to recognize present status of the data sending units 4-1 ~ 4-n in the system (S 111). Receiving said status acquisition command, each data sending unit 4-1 ~ 4-n, using the status report section 41, reports its sending status to the control unit 2 in a way shown in Figure 5. The control unit 2, using the determining section 22, determines a various status of operating data sending units 4-1 ~ 4-n from the report, including status change from no data sending to data sending, addition or deletion of the data sending unit, and unit or power failure.

When a data sending status change or a unit status abnormality is detected by said determining section 22(S 113), the control unit, referring to an information of the data sending unit having status change or abnormality or to a scheduling data of the schedule section 23, issues the data sending request command to other normal unit among the data sending units 4-1 ~ 4-n (S 114). The normal data sending unit receiving said command sends the dummy data, which is to be transmitted from the dummy data sending section 44, to the path specified (S 115). As described above, the control unit 2 maintains a close watch, in its operation, on the paths with no data sending or the data sending units abnormality, and controls dummy data sending accordingly. Thus, false parity error detection in the receiving units can be avoided.

In the case of Figure 5 and Figure 6, on the other hand, when all the data sending units 4-1 ~ 4-n are instructed via the console not to send any data, the determining section 22 of the control unit 2 determines

that a path with no data exist (S 103 or 113), and instructs a specific data sending unit, based on a scheduling of the schedule section 23, to send the dummy data. The instructed data sending unit sends the dummy
5   data using dummy data sending section 44 (S 104, 105, or S 114, 115).

       Meanwhile, when each data sending unit 4-1 ~ 4-n itself detects an abnormality of the control path 8-1, the data sending unit stops sending data or dummy data by
10   itself to behave in a way as if it is eliminated from the system. A specific explanation regarding this function will be presented in the second embodiment next to be described.

       Figure 7 (a) and Figure 7 (c) represent the second
15   embodiment of this invention.

       As explicitly shown in Figure 7, the control unit 2 for central management of the dummy data sending control (see Figure 3 (a)) does not exist in this embodiment. The dummy data sending control is performed by each data
20   sending unit 4-1 ~ 4-n, which recognizes the other's unit status alternately through the control path 8-1. In a system constitution shown in Figure 3 (a), the dummy data sending control itself, in the invention herein presented, becomes impossible by a failure of the control
25   unit 2 unless a pair of the control units have been arranged. In this embodiment, on the other hand, the units for dummy data sending control are distributed among each data sending unit 4-1 ~ 4-n to provide more solid, simple network for executing this invention.

30   Figure 7 (b) and Figure 7 (c) are the graphic representations showing specific block constitutions of the data sending units 4-1 ~ 4-n in this embodiment. Figure 8 and Figure 9 are flow charts showing the dummy data sending control based on the constitution
35   represented in Figure 7 (a) and Figure 7 (c). The following explanation will be presented by referring to

these figures.

In Figure 8, each data sending unit 4-1 ~ 4-n starts
by being supplied with power, and subsequently,
communicates with other units and selects a master unit
5   performing the function equivalent to that of the control
unit 2 shown in Figure 3. A predetermined algorithm,
which specifies a first or last unit with power supply,
or a unit selected by using certain random number list,
is employed in the master unit selection (S 201). The
10   determining section 46 performs a process for said master
unit selection.

Once selected, the master unit controls, just like
the control unit 2 shown in the figure 5 and Figure 6,
dummy data sending of other slave units which function as
15   data sending unit (S 202 ~ S 206). It is noted that the
regular process flow chart represented in Figure 6 is not
shown in this embodiment. It is omitted since it is
identical with that of this embodiment. It is also noted
that the block constitution of the data sending unit 4-n
20   shown in 7 (b) comprises that of control unit 2 and the
data sending unit 4-n shown in the Figure 3 (b), so that
the data sending unit 4-n in this embodiment can work
both as master unit and slave unit. Therefore, no further
explanation will be presented for these units. Additional
25   blocks indicate the units having functions that can be
arranged by additional software.

A failure watch section 48 shown in Figure 7 (c),
which is particular to this embodiment, watches
constantly or periodically a failure of the master unit
30   and the control path to detect their abnormality. Figure
9 is a flow chart representing a process to be executed
by the determining section 46 in accordance with the
watch result. The failure detection on the master unit by
the failure watch section 48 is to be performed, for
35   example, as follows. As shown in Figure 6, the master
unit periodically transmits the status identification

command to the slave unit (S 111). Without receiving said
command from the master unit after a predetermined time
has passed, the slave unit determines that the master
unit has failed. In this case, the slave unit, on
5   detecting the master unit failure, starts a process for
selecting a new master unit among other slave units (S
201 in Figure 8). Then a newly selected master unit
continues the subsequent process.

The step S 212, shown in Figure 9, represents a
10   process where the slave unit detects a failure in the
control path 8-1 - for example, a breaking of wire or
abnormal increasing of error rate - and stops working (S
213). The stopped slave unit is in a status of being
separated from the path (through path). This process
15   prevents a situation that an effect produced by a serious
failure, such as the control path failure, grows more
complicated as it pass through each node in the ring
network.

While a distributed constitution comprising the
20   master and slave units is described above, other
constitutions are by no means eliminated. It is also a
possible constitution where each data sending unit 4-1 ~
4-n has an information of other data sending units
through the control path 8-1, by which each data sending
25   unit makes its own decision to control the dummy data
sending.

Figure 10 (a) and Figure 10 (b) represent the third
embodiment of this invention. Figure 11 is a flow chart
representing the dummy data sending control shown in
30   Figure 10 (a) and Figure 10 (b).

As explicitly shown in Figure 10 (a), no controlling
path is employed in this embodiment. Each data sending
unit 4-1 ~ 4-n is under instruction from the scheduling
section 47, having predetermined schedule, which is shown
35   in Figure 10 (b) (S 301). The data sending section 43 in
the sending/receiving section 42 sends the data, and the

dummy sending section 44 sends a dummy data required (S
302). When the contents of the schedule is to be changed,
an operator is obliged to change a setup of each data
sending unit 4-1 ~ 4-n manually. Providing such a simple
5   constitution described above allows the invention herein
presented to be applied in a network with smaller scale,
wherein the dummy data sending control disclosed by this
invention prevents the detection of false parity error in
the data receiving unit.

10   As described heretofore, this invention presents the
system with plural data sending units having plural
logical paths, each data sending unit being able to send
the data freely to each logical path. In the system
presented, when a time span with no data insertion
15   happens to exist during the time a plurality of the data
sending units change the insertion data in a time sharing
order on the same path, unnecessary error detection can
be avoided as the predetermined data sending unit sends
the dummy data with an appropriate parity added. The data
20   sending unit detects an abnormality in the network, which
can also prevent a flow of unstable data in the network.
        The dummy data sending described in this invention
can be performed by central control with control unit, or
by distributed control with interacting data sending
25   units, or by stand-alone control with individual unit.